Possessives in Naturally Occurring Discourse: A Centering Approach

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1 Introduction

Centering is a model of the conversants' center of attention in a discourse that is concerned with the relationship of attentional state, inferential complexity, and the form of referring expressions (Walker, Joshi and Prince 1998). The basic claims of this theory are that certain entities mentioned in an utterance are more central than others and that this property imposes constraints on a speaker's use of different types of referring expressions. Following this framework, the more central an entity is, the more liable it is to be represented by a pronominal.

Possessives as a type of pronominal have peculiar characteristics. An NP that contains a possessive adjective in fact refers to two different entities, the Possessor (P_{or}) and the Possessed (P_{ed}). How to deal with possessives is one of the open issues in centering. The problem is to explain how these two entities function in a discourse, both as a link to the previous discourse and as a prediction of the subsequent discourse.

This paper is based on a corpus study, since we need to see how speakers actually use these expressions in naturally occurring discourse to settle this issue. This paper will examine how these two entities function in naturally occurring discourse. As centering is intended as a model of local discourse coherence, the goal of this paper is to show how the two entities referred to by possessives affect that coherence in naturally occurring discourse.

2 Centering Model

Centering is proposed as a model of the local-level component of attentional state (Grosz, Joshi and Weinstein 1995).[1] They propose that there are inter-

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[1] Centering fits within the theory of discourse structure developed by Grosz and Sidner (1986). It distinguishes three components of discourse structure: a linguistic

actions between local coherence and choices of referring expressions and that differences in coherence correspond in part to the different inferential load created by different types of referring expressions, given a particular attentional state.

The centering model is very simple. Discourses are made up of constituent discourse segments. Each discourse segment consists of utterances. Centers are semantic entities that are part of the discourse model for each utterance in a discourse segment. There are three types of centers, which are not mutually exclusive. The Forward-looking Centers (Cfs) are the set of discourse entities realized in the utterance. They are ranked according to discourse saliency. The Backward-looking Center (Cb) is a special member of the Cfs, which represents the discourse entity the utterance most centrally concerns. It is similar to what is elsewhere called the "topic". This Cb entity is assumed to link the current utterance to the previous discourse. The Preferred Center (Cp) is the highest ranked member of the Cfs. This Cp is assumed to represent a prediction about the Cb of the following utterance. A key aspect of centering theory is the distinction between looking back to the previous discourse with the Cb and projecting preferences for interpretation in a subsequent discourse with the Cp (Walker and Prince 1996, Walker, Joshi and Prince 1998).

In addition to the center structure, centering theory defines a set of constraints and rules. Three constraints are given in (1):

(1) For each utterance U_i in a discourse segment D consisting of utterances $U_1,\ldots,U_m$:
   a. There is precisely one backward-looking center $Cb(U_i, D)$.
   b. Every element of the forward-looking center list, $Cf(U_i, D)$, must be realized in U_i.
   c. The center, $Cb(U_i, D)$ is the highest-ranked element of $Cf(U_{i-1}, D)$ that is realized in U_i.

Since there is no Cb in an initial utterance of a discourse segment, (1a) means that there is "at most" one Cb. The Cb is the most central discourse entity that the utterance is about. Constraint (1b) relies on the definition of "realization". Even though the exact definition of realization depends on the semantic theory that one adopts, (forward-looking) centers are not confined

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structure, an intentional structure and an attentional state. At the level of linguistic structure, discourse consists of constituent discourse segments. The intentional structure includes intentions and relations among them. Attentional state is a model of the discourse participants' focus of attention at any given point in the discourse.

to explicitly evoked discourse entities. Constraint (1c) states that the ranking of Cfs determines the Cb for the next utterance.

There are also two (preference) rules in centering:

(2) For each U_i in a discourse segment D consisting of utterances U_1, ...,U_m:
   a. If some element of $Cf(U_{i-1}, D)$ is realized as a pronoun in U_i, then so is $Cb(U_i, D)$.
   b. Transition states are ordered. The CONTINUE transition is preferred to the RETAIN transition, which is preferred to the SMOOTH-SHIFT transition, which is preferred to the ROUGH-SHIFT transition.

Rule (2a) is called the Pronoun Rule; it captures the intuition that the prototypical way of realizing Cb is a pronominal. If there are multiple pronouns in an utterance, then one of them must be the Cb. And if there is only one pronoun, it will be the Cb. Rule (2b) presents several types of transitions that can be used to measure the coherence of the discourse segment in which the utterance occurs. It claims that discourses that continue the center are more coherent than those that repeatedly shift from one center to another.

The definition of transition states from Brennan, Friedman and Pollard (1987) is summarized in Table 1.

	$Cb(U_i) = Cb(U_{i-1})$ OR $Cb(U_{i-1}) = [?]$	$Cb(U_i) \neq Cb(U_{i-1})$
$Cb(U_i) = Cp(U_i)$	CONTINUE	SMOOTH-SHIFT
$Cb(U_i) \neq Cp(U_i)$	RETAIN	ROUGH-SHIFT

Table 1: The Definition of Transition States

The type of transition from one utterance, U_{i-1}, to the next utterance, U_i, is based on two factors: whether the Cb of each utterance is the same and whether the Cb of U_i is the same as the Cp of U_i. The notation "$Cb(U_{i-1}) = [?]$" is used for cases where there is no $Cb(U_{i-1})$, that is, discourse segment initial cases.

3 Possessives in the Cf Ranking

Following the centering framework presented in the previous section, pronominalization is regarded as a way of indicating discourse saliency. The Pronoun Rule (2a) implies the following generalization: The more central an

entity is, the more likely it is to be represented by a pronominal. Pronouns are most likely to represent the Cb entities. This is the reason centering is used for pronoun resolution.

Possessives, as a type of pronominal, have peculiar characteristics in this respect. An NP that contains a possessive adjective refers in fact to two different entities, P_{or} and P_{ed}, rather than one. So, what is the discourse saliency between the two entities? Which one can be assumed to be more central in a speaker's attention? In terms of centering, the problem can be equated to how these two entities affect Cb determination and Cf ranking.

Cf ranking is a very important component in centering, since it determines the Cb of the subsequent utterance and the type of transition state between the two utterances. However, a widely adopted Cf ranking like (3) cannot cope with more complex cases like possessives. Because this ranking refers only to grammatical function, a possessive NP will be treated as a whole.

(3) Cf ranking by grammatical function
(Brennan, Friedman and Pollard 1987)
Subject > Object(s) > Others

As a more elaborate Cf ranking, there are two possible approaches to Cf ranking for possessives. One is the Complex NP Assumption, from Walker and Prince (1996), as follows:

(4) The Complex NP Assumption
In English, when an NP evokes multiple discourse entities, such as a subject NP with a possessive pronoun, we assume that the {Cf} ordering is from left to right within the higher NP.[2]

The other one is from Di Eugenio (1998). Her working heuristics are as follows: P_{ed} corresponds to the full NP, and thus its position in Cf ranking is determined by the NP's grammatical function; as regards P_{or}, it is ranked as immediately preceding P_{ed} if P_{ed} is inanimate, and as immediately following P_{ed} if P_{ed} is animate.

To compare two approaches, consider the following (contrived) discourse from Di Eugenio (1998).

[2] The Cf ranking by grammatical function like (3), supplemented by the Complex NP Assumption, yields an order very close to surface order.

(5) a. I met $Mary_i$ yesterday.
b. She_i was worried
c. i) Her_i $husband_j$ was in the hospital.
ii) Her_i car_k wasn't working.

The Cb of (5c) will be Her_i (=Mary), whether (5b) is followed by (5ci) or (5cii). As for the Cf ranking, the two approaches offer different analyses. The difference lies in the case of (5ci). Walker and Prince (1996) assume P_{or} ($Mary_i$) precedes P_{ed} ($husband_j$), but Di Eugenio (1998) assumes P_{or} ($Mary_i$) follows P_{ed} ($husband_j$). In other words, the former approach predicts that the following utterance will be about $Mary_i$ rather than (her) $husband_j$, but the latter predicts that it will be about (her) $husband_j$ rather than $Mary_i$.

The question is whether the animateness of P_{ed} is the determining factor of Cf ranking or not. This can be settled by examination of the subsequent discourse, whether the following utterance is about P_{or} or P_{ed}. Since both are possible options relevant to local discourse coherence, what is crucial is which one is more frequently used in naturally occurring discourse. In other words, what matters is how speakers actually use these expressions. That is why we need a corpus study for this problem.

4 A Corpus-based Study on Possessives

4.1 Corpus and Method

The corpus source for this study is Linguistic Data Consortium (LDC) online. The corpus from which I collected utterances containing possessives is LDC93TI ACL/DCI. It consists of the Brown Corpus, and the Wall Street Journal from 1987, 1988 and 1989. The data type is whole paragraphs containing utterances that have the sentence-initial possessive "His". There are 7836 data tokens in the corpus.

The reason this paper confines the data to the sentence-initial cases is that sentence-initial position is a salient position in terms of discourse, especially in maintaining the local coherence of the context. Possessives in other positions may have the same function, but they can have only the referring function that is less significant in view of local discourse coherence. In other words, we assume some discourse preference as regards this position. According to the Cf ranking in (3), a subject NP is the most highly ranked element, so it is the most liable Cb in the following utterance. Our concern is which entity, P_{or} or P_{ed}, is more central in discourse, having granted that the whole NP has a dominant status in discourse.

Our method examines the Cb of the utterance that contains the possessive NP and that of the Cb of the subsequent utterance to see how possessives affect Cb determination and Cf ranking. Because Cb is determined by the Cf ranking of the preceding utterance following the constraint (1c) and the Cf ranking between two entities of possessive NP is not yet determined, we must see which entity is actually referred to in the subsequent utterance.

Since we are going to examine whether the animateness of P_{ed} is the determining factor of Cf ranking, data tokens are tagged according to the animateness of P_{ed}, "+Animate" or "-Animate". However, there are cases where it is hard to decide the animateness of P_{ed}. Lexical items such as *government*, *company*, *country*, etc. denote entities which are intrinsically not animate but can be interpreted to denote the animate members of the entity. These cases are tagged as "?Animate". Thus, data tokens are classified into three sets, "+Animate", "-Animate" and "?Animate".

The position of the utterance in the paragraph is also considered. Since our concern is to see how possessives affect local discourse coherence, we examine the correspondence with the surrounding utterances. The examination of the Cb will show the link to the previous utterance and the examination of the following utterance will show the connection to the subsequent utterance. Paragraph-initial utterances will be exempt from the examination of correspondence with the preceding utterance. On the other hand, paragraph-final utterances will be exempt from the examination of correspondence with a following one.

4.2 Assumptions for Data Analysis

We make some assumptions for data analysis. Since many issues are open in analyzing naturally-occurring data in terms of centering, we need to assume some basic rules of analysis. They include defining the discourse segment boundary, Cf ranking and center-update units in more complex sentences.

This paper will assume discourse segment boundaries to be the beginning and end of a paragraph. It may be a simplification, but since our corpus consists of written text rather than speech data, the paragraph is the most plausible candidate for discourse segment.[3] As for Cf ranking, Cf ranking (3) by grammatical function will be adopted.

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[3] Walker (1989) assumes a new paragraph begins a new segment "unless the first sentence has a pronoun in subject position or a pronoun where none of the preceding sentence-internal noun phrases match its syntactic features". This paper doesn't distinguish cases with pronouns from others. However, paragraph-initial pronouns seem to have peculiar characteristics. This will be discussed in Table 5.

The center-update unit in more complex sentences is an open issue in centering. There are two approaches to this issue, one sentence-based and one clause-based, each of which has its advantages and disadvantages in handling naturally occurring discourse. In this study, an utterance is defined as a tensed clause, following some previous work (Kameyama 1998, Hurewitz 1998, Chae 2000).[4] Utterances are easy to handle by this approach and it can deal with intrasentential anaphoric dependencies as well as intersentential ones. However, if needed, the alternative approach can be adopted for comparison. Actually, 4.3.2 presents both types of approaches.

Another assumption of this paper is as regards the referentiality of NPs. If we consider the following pair, there is some difference in the interpretation of the possessives.

(6)a. **His opponent in the primary, John Eagan**, is a former chairman of the Philadelphia Stock exchange who himself switched parties in 1983.

b. **His opponent in next year's election** will be Eduardo Angeloz, governor of Cordoba state and the hand-picked candidate of Mr. Alfonsin, who is constitutionally barred from running for re-election.

The possessive NP of (6a) denotes the entity of the appositive NP, **John Eagan**. On the other hand, that of (6b) doesn't seem to directly denote some entity, but it describes the characteristics of the entity that this expression denotes. Grosz, Joshi and Weinstein (1995) uses the terms "a value-loaded (VL) interpretation" and "a value-free (VF) interpretation" to distinguish this difference. Even though centering doesn't exclude either type of interpretation, this paper will focus on referential cases like (6a).

There are many other data excluded in this study. Since the main issue here is to see how P_{or} and P_{ed} of the sentence-initial possessive NP affect the local discourse coherence, data irrelevant to this purpose are excluded. The following expressions in the corpus were excluded from analysis: sentence fragments that don't form a whole sentence, headlines, in which all words rather than only sentence-initial ones are usually capitalized, and set phrases such as *His Highness*, *His Excellency*, and more complex NPs like *His mother's death*, etc.

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[4] Nominal clauses and restrictive relative clauses, however, are not regarded as utterances.

4.3 Data Analysis

The data analysis is divided into two parts. The first part is the result from the first 500 data token set. For this set, correspondence with the surrounding utterances is examined. The second part is the result from the whole set. Since our main concern is animate P_{ed}, all possessives with animate P_{ed} from the corpus are examined in the second part.

4.3.1 The Correspondence with the Surrounding Utterances

As for the first 500 data token set, the correspondence with the surrounding utterances is examined to show how the two entities referred to by a possessive affect Cb determination and Cf ranking. Since our data are confined to those of sentence-initial possessives, it is predicted that they will show more salience and more likely to be Cbs than possessives in general.

Table 2 shows correspondence with the preceding utterance.

	P_{or}	P_{ed}	Others	Sub Total	DNA (Initial)	Total
+Animate	80 (100%)	0	0	80	5	85
-Animate	269 (96.4%)	6 (2.1%)	4 (1.4%)	279	47	326
?Animate	15 (93.8%)	0	1 (6.3%)	16	0	16
Total	364 (97.1%)	6 (1.6%)	5 (1.3%)	375	52	427

Table 2: Correspondence with the Preceding Utterance[5]

From the 500 data tokens, some are excluded for the reasons provided in 4.2, so the actually analyzed data comprises 427 tokens. Since this table deals with correspondence with the preceding utterance, paragraph-initial utterances will be cases of DNA ("do not apply"). Data are classified into three sets according to the animateness of P_{ed}. The head of each row designates the animateness of P_{ed}. For each category, we note which entity, P_{or} or P_{ed}, is the Cb of the utterance that contains the possessive NP. This table shows P_{or} is far more likely to be the link to the previous discourse, regardless of the

[5] The percentage provided in the parenthesis is relative to the sub total, the count of actually analyzed cases. Percentages may not add up to 100% due to rounding. The same applies to Table 3.

animateness of P_{ed}. This result agrees with the prediction for sentence-initial possessives.

Table 3 shows correspondence with the following utterance. This result is from the observation of which entity the following utterance of the possessive NP containing utterance refers to. This correspondence is not as simple as that of Table 2. As a whole, following utterances tend to refer to the P_{or} entity most, about half of the whole. However, there are differences between animate P_{ed} cases and inanimate P_{ed} cases. Utterances following possessive NP with inanimate P_{ed} or ?animate P_{ed} show the same tendency where P_{or} is more likely to be the referred-to entity. However, cases with animate P_{ed} show the opposite tendency, that is, utterances that refer to P_{ed} are more than those that refer to P_{or}.

	P_{or}	P_{ed}	Others	Sub Total	DNA (Final)	Total
+Animate	22 (36.7%)	25 (41.7%)	13 (21.7%)	60	25	85
-Animate	121 (55.3%)	51 (23.3%)	47 (21.5%)	219	107	326
?Animate	4 (36.4%)	2 (18.2%)	5 (45.5%)	11	5	16
Total	147 (50.7%)	78 (26.9%)	65 (22.4%)	290	137	427

Table 3: Correspondence with the Following Utterance

This result appears to support De Eugenio's (1998) heuristics. However, the data set is too small to conclude this firmly and the difference between utterances with P_{ed} (41.7%) and those with P_{or} (36.7%) doesn't seem to be meaningful. This is why the second part of the study is needed.

4.3.2 The Correspondence for Possessives with Animate P_{ed}

Since the main issue of this paper is whether the animateness of P_{ed} is the determining factor of Cf ranking or not, the correspondence with the following utterance was examined for all data tokens with animate P_{ed} in the corpus. Table 4 shows the result from all occurrences of possessives with animate P_{ed} in the corpus.

As pointed out in 4.2, this study assumes an utterance to be a tensed clause. However, this assumption seems to affect the result of correspondence between utterances. Consider the following data from the corpus.

(6) a. i) **His grandfather** left Ireland in 1845,
ii) went to work for the New England Brick Co.,
iii) and used a wheelbarrow, a pick and a shovel to make bricks.
b. i) **His father** was elected to the Cambridge City Council
ii) and was superintendent of sewers, a job prized for its patronage.
a. **Thomas O'Neil Jr. himself** was known around the neighborhood as a "narrowback"—not fit for good labor because his parents were born in America.

Following our assumptions, this discourse is composed of six utterances and the second utterance will be (7aii). Since this utterance has a null subject that denotes the same entity as the subject of the previous sentence, it is the case that the P_{ed} entity rather than P_{or} is referred to. However, if a sentence as a whole is assumed to be an utterance, this discourse is made up of three utterances and the second utterance is (7b). In this case, P_{or} rather than P_{ed} is referred to. This case shows that the result of correspondence between utterances interacts with the assumption as regards center-update units. For fairness, both approaches are provided in Table 4.

	P_{or}	P_{ed}	Neither	Both	Total
Clause Based	337 (36.6%)	371 (40.2%)	189 (20.5%)	25 (2.7%)	922
Sentence Based	358 (44.9%)	260 (32.6%)	156 (19.5%)	24 (3.0%)	798

Table 4: Correspondence for the Animate P_{ed} Cases[6]

When the clause-based approach is assumed, the following utterance is more liable to refer to P_{ed} than P_{or}. In other words, the animate P_{ed} is more liable to be the Cp of the following utterance than P_{or} is. On the other hand,

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[6] The column header "Neither" of Table 4 designates the cases when the following utterance doesn't refer to either of P_{or} or P_{ed}. And "Both" designates when the two entities, P_{or} and P_{ed}, are referred to together, usually in a composite entity as in the following discourse.

a. Tsuneo Hirosawa is a cab driver in the nearest big city, Shirakawa.
b. i) **His wife** sells fertilizers and chemicals,
ii) and together **they** make about $32,000.
c. A little more than $10,000 of that comes from their 112-acre farm, including rental income. ...

The Cb of (bii) is **they**, which are composed of P_{or} (**His**) and P_{ed} (**wife**) in the preceding utterance.

if we assume sentences to be the center-update units, the result is reversed. In the latter case, P_{or} is the most liable Cp of the following utterance. So, from these results, it is hard to conclude that animate P_{ed} should be higher than P_{or} in the Cf ranking. Moreover, even with a clause-based approach, the difference between P_{ed} (40.2%) and P_{or} (36.6%) doesn't seem to be meaningful.

Among possessives with animate P_{ed}, however, discourse-segment (paragraph)-initial cases show some different tendencies. Table 5 shows result from paragraph-initial animate P_{ed} cases

	P_{or}	P_{ed}	Neither	Both	Total
Clause Based	48 (29.8%)	83 (51.6%)	27 (16.8%)	3 (1.9%)	161
Sentence Based	53 (33.8%)	76 (48.4%)	25 (15.9%)	3 (1.9%)	157

Table 5: Result from the Discourse-Segment-Initial Animate P_{ed} Cases

When the possessives with animate P_{ed} are discourse segment initial, the tendency that the following utterance refers to the P_{ed} entity becomes more dominant, whatever center-update unit we assume. And the difference between the P_{ed} cases and the P_{or} cases increases. We can say that if a paragraph starts with a possessive NP and the P_{ed} is animate, the following discourse is more liable to be about the P_{ed} entity.[7]

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[7] This tendency can be independent of the animateness of P_{ed}. In other cases, however, there are many data hard to compare between P_{or} and P_{ed}. Out of 52 paragraph-initial possessives from the first 500 data token set, the occurrences of each in the following utterance are as follows: P_{or} – 21 (40.4%), P_{ed} – 10 (19.2%), Others – 10 (19.2%), Ambiguous – 11 (21.2%). "Ambiguous" designates such cases as follows:

a. **His method** of choosing key people was equally personal.
b. i) To a large extent, especially in the beginning, **he** had to choose from among people already on the staff,
   ii) and that was always **his** preference.
c. i) When **he** needed a new managing editor or editor,
   ii) **he** would choose, in part, by past performance—but also in part by his intuitive feelings of whether the person could deal larger responsibilities.
d. In that way **he** was remarkably successful.

This discourse segment as a whole seems to be about **His method**, that is, P_{ed}. However, what is referred to in each of next utterances is **he**, so the P_{or} will be the Cb rather than P_{ed}. Unlike cases of possessives with animate P_{ed}, in which it is easy to determine whether the following utterance is about P_{ed} or P_{or}, in these cases it is not so simple and easy to determine. P_{ed} and P_{or} seem to be on different levels. This phenomenon seems to be related to the difference between discourse topic and sentence

5 Conclusions

From our observation, each of the two entities of a possessive NP has its own discourse function. What this study means to show is how the two entities affect Cb determination and Cf ranking and whether animateness of P_{ed} has an effect on the determination of Cf ranking. As for Cb determination, P_{or} seems to be the preferred determining entity. Since P_{or} is a pronominal, this result confirms the general claim of the centering framework. As for Cf ranking, the animateness of P_{ed} seems to affect Cf ranking in some extent, but it doesn't seem to be the determining factor. According to our assumption on the center-update unit, there are cases where the P_{ed} entity is more liable to be the Cp of the following utterance than P_{or} is. But this tendency is not so distinctive that we can put P_{ed} higher than P_{or} in the Cf ranking. So, we conclude that P_{or} should be ranked higher than P_{ed}, following the Complex NP Assumption.

However, the animateness of P_{ed} seems to have another discourse function. When a discourse segment starts with a possessive with animate P_{ed}, the following utterance is usually about P_{ed} rather than P_{or}. And when we assume the center-update unit to be a clause, the following utterance (clause) is liable to refer to P_{ed} no less than P_{or}. If we assume the (complex) sentences composed of constituent clauses constitute lower discourse segments, the latter case can be incorporated into the former case. From these two observations, the discourse-segment-initial possessives with animate P_{ed} seem to function as a marker of a lower discourse structure, which is about P_{ed} rather than P_{or}.

References

Brennan, Susan E., Marilyn W. Friedman and Carl J. Pollard. 1987. A Centering Approach to Pronouns. In *Proceedings of 25th Annual Meeting of the Association of Computational Linguistics*, Stanford, CA.

Chae, Sook-Hee. 2000. A Centering Approach to Complex Sentences in English. Doctoral Dissertation. Seoul National University.

Di Eugenio, Barbara. 1998. Centering in Italian. In *Centering Theory in Discourse*, eds. Marilyn A. Walker, Aravind K. Joshi and Ellen F. Prince, 115-38. New York: Oxford University Press.

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topic (Reinhart 1981). Since we cannot deal with these other cases consistently with cases of possessives with animate P_{ed}, we will leave the question of how to handle them open.

Grosz, Barbara J., Aravind K. Joshi and Scott Weinstein. 1995. Centering: A Framework for Modeling the Local Coherence of Discourse. *Computational Linguistics* 21:2, 203-25.

Grosz, Barbara J. and Candace L. Sidner. 1986. Attentions, Intentions and the Structure of Discourse. *Computational Linguistics*, 12, 175-204.

Hurewitz, Felicia. 1998. A Quantitative Look at Discourse Coherence. In *Centering Theory in Discourse*, eds. Marilyn A. Walker, Aravind K. Joshi and Ellen F. Prince, 273-92. New York: Oxford University Press.

Kameyama, Megumi. 1998. Intrasentential Centering: A Case Study. In *Centering Theory in Discourse*, eds. Marilyn A. Walker, Aravind K. Joshi and Ellen F. Prince, 89-114. New York: Oxford University Press.

Reinhart, Tanya. 1981. Pragmatics and Linguistics: An Analysis of Sentence Topics. *Philosophica* 27, 1-38.

Walker, Marilyn A. 1989. Evaluating Discourse Processing Algorithm. In *Proceedings of the 27th Annual Meeting of the Association for Computational Linguistics*, 251-261. Vancouver, Canada.

Walker, Marilyn A. and Ellen F. Prince. 1996. A Bilateral Approach to Givenness: A Hearer-Status Algorithm and a Centering Algorithm. In *Reference and Referent Accessibility*, eds. Thornstein Freitheim and Jeanette K. Gundel, 291- 306. Amsterdam/Philadelphia: John Benjamins.

Walker, Marilyn A., Aravind K. Joshi and Ellen F. Prince, eds. 1998. *Centering Theory in Discourse*. New York: Oxford University Press.

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